Document - 4205605

FIG 1

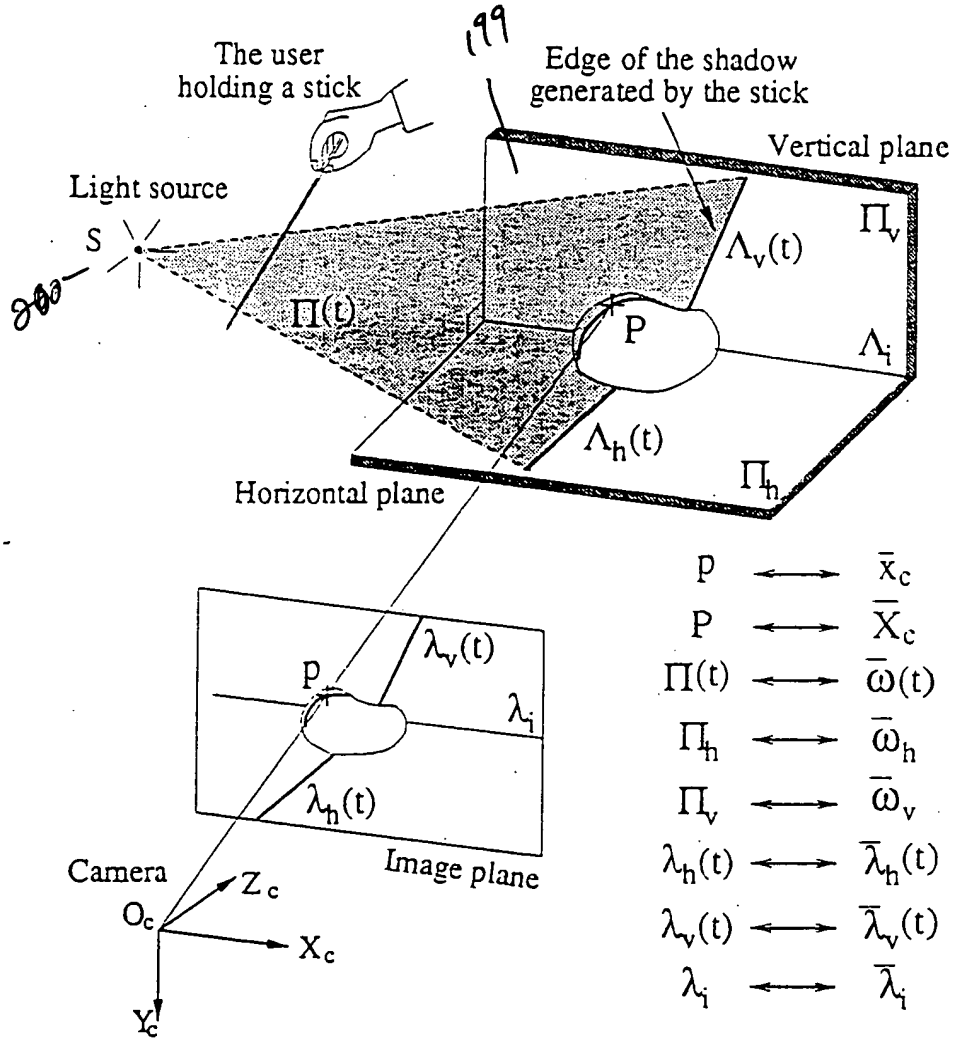

199
The user holding a stick
Edge of the shadow generated by the stick
Vertical plane
Light source
S
Π_v
$\Lambda_v(t)$
$\Pi(t)$
P
Λ_i
$\Lambda_h(t)$
Π_h
Horizontal plane
p
$\lambda_v(t)$
λ_i
$\lambda_h(t)$
Image plane
Camera
O_c
Z_c
X_c
Y_c
$p \longleftrightarrow \bar{x}_c$
$P \longleftrightarrow \bar{X}_c$
$\Pi(t) \longleftrightarrow \bar{\omega}(t)$
$\Pi_h \longleftrightarrow \bar{\omega}_h$
$\Pi_v \longleftrightarrow \bar{\omega}_v$
$\lambda_h(t) \longleftrightarrow \bar{\lambda}_h(t)$
$\lambda_v(t) \longleftrightarrow \bar{\lambda}_v(t)$
$\lambda_i \longleftrightarrow \bar{\lambda}_i$

FIG. 2

300 — Calibration - find Π_H position

305 — obtain Image of the shadow
- i) shadow times at each pixel
- ii) locate projections

310 — Convert projections (λ) into actual shadow info (Λ)

315 — Find shadow plane

320 — Find P α X_c by triangulation

FIG 3

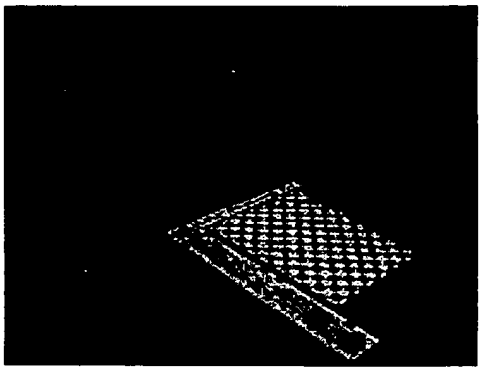


FIG 4A

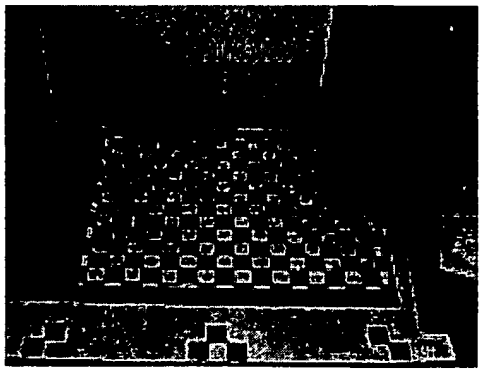


FIG 4B

6,950,462 - 6,950,462 - 6,950,462

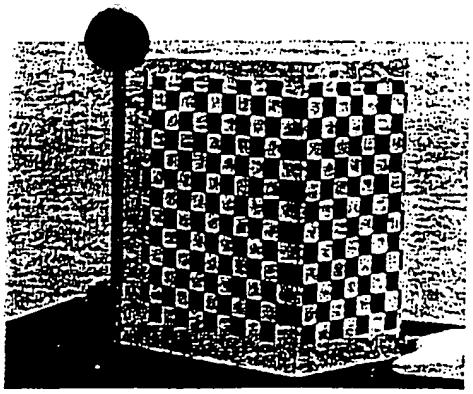


FIG. 5

0930505 - 050504

FIG. 6A

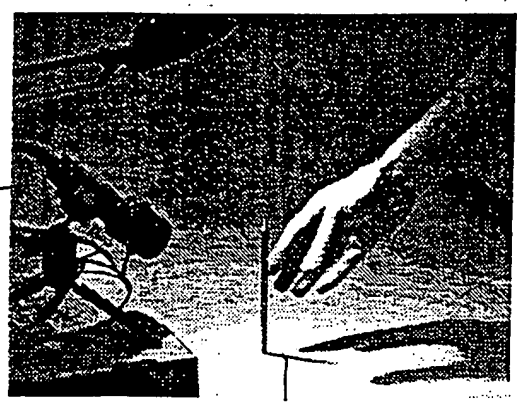
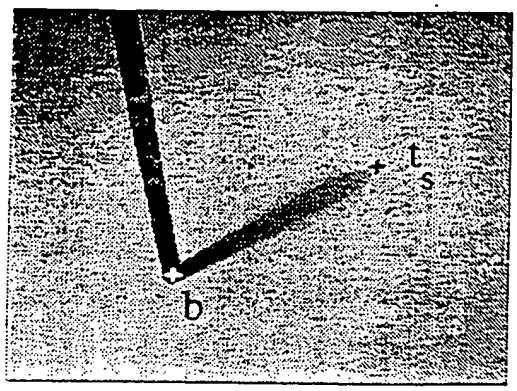


FIG. 6B



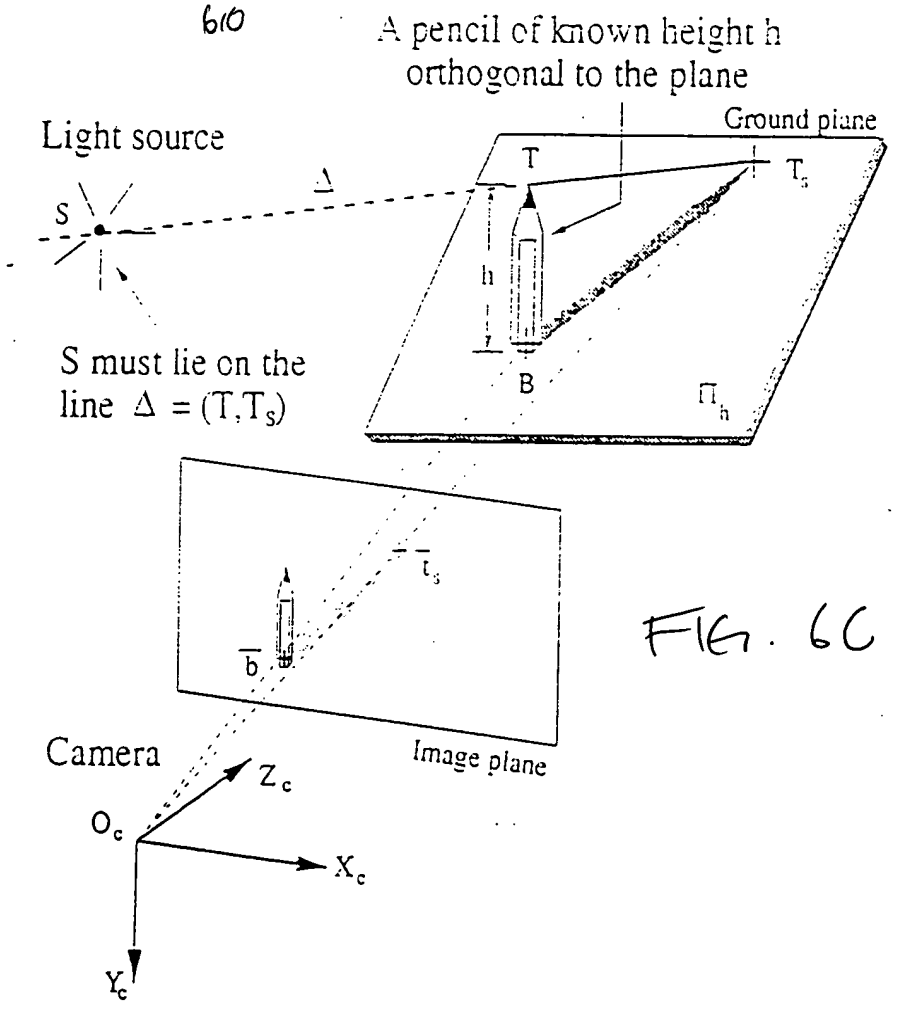


FIG. 6C

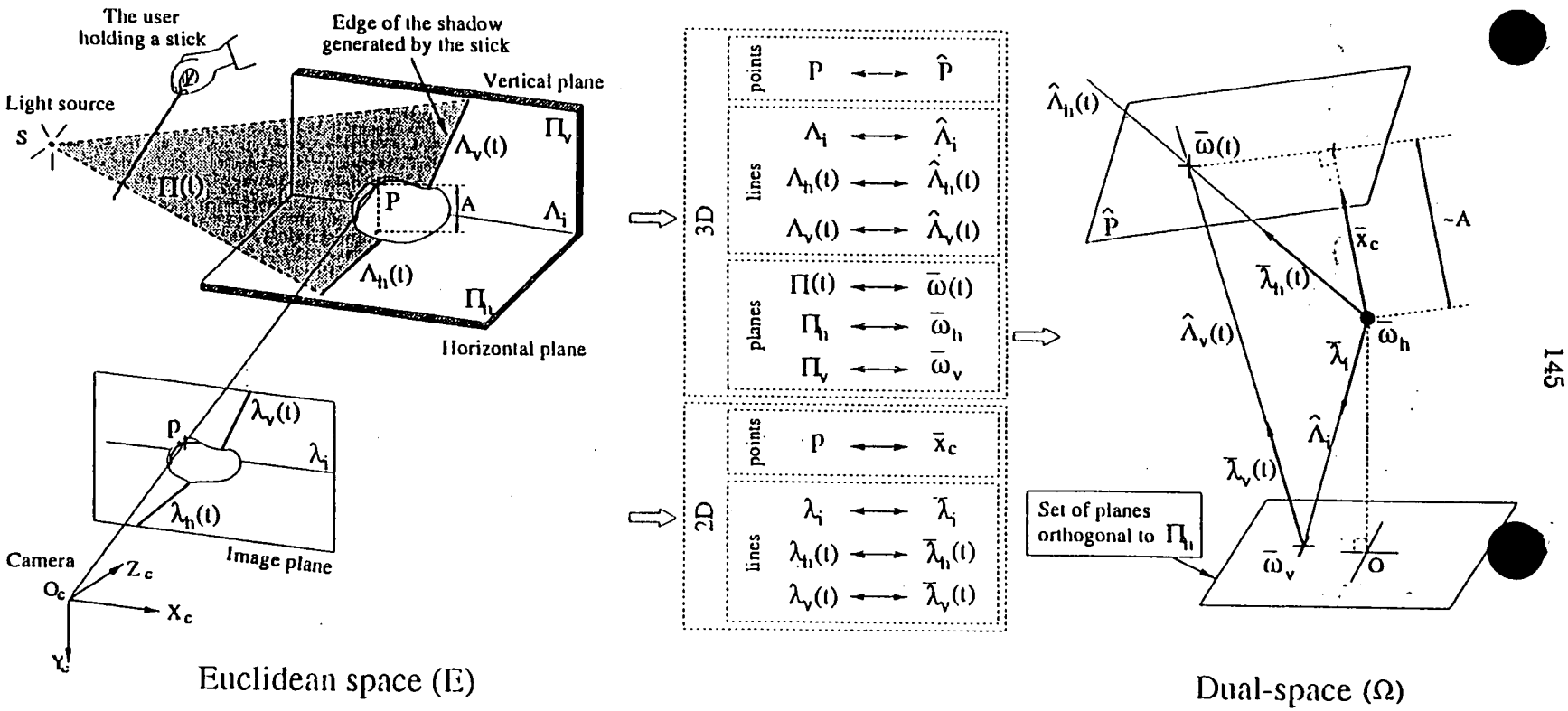

The user holding a stick
Edge of the shadow generated by the stick
Light source
S
Vertical plane
Horizontal plane
P
A
Camera
Image plane
Euclidean space (E)
3D
2D
points
lines
planes
Set of planes orthogonal to
Dual-space (Ω)

Fig. 7

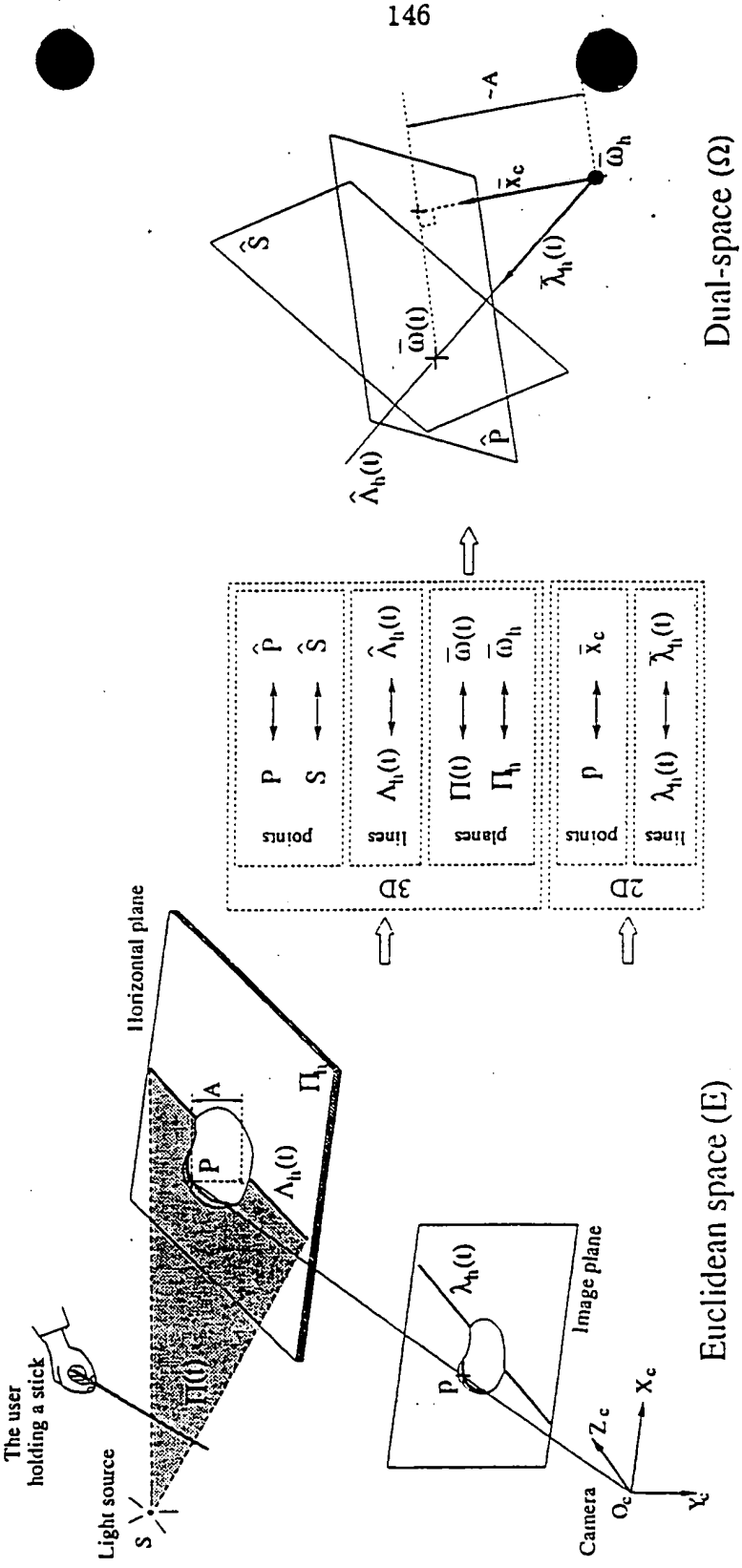

Euclidean space (E)
Dual-space (Ω)
2D
3D
points
lines
planes
points
lines
Horizontal plane
Image plane
Camera
Light source
The user holding a stick
P
A
-A

FIG. 8

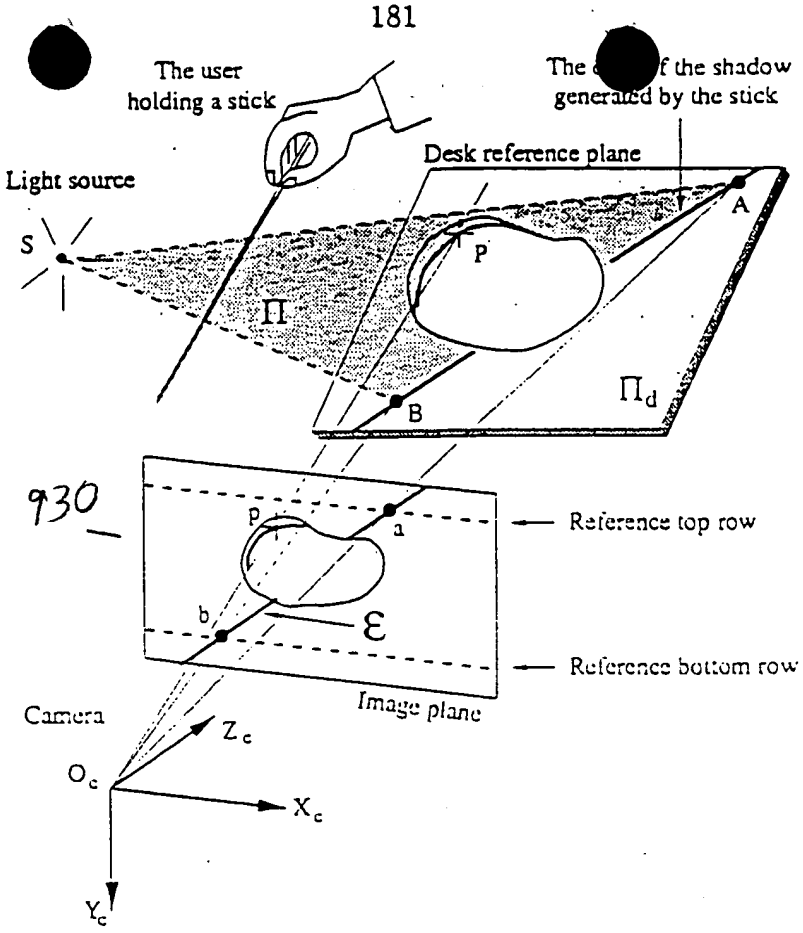

The user
holding a stick
The shadow
generated by the stick
Desk reference plane
Light source
S
A
P
Π
Π_d
B
930
p
a
Reference top row
b
ε
Reference bottom row
Image plane
Camera
Z_c
O_c
X_c
Y_c

FIG.9

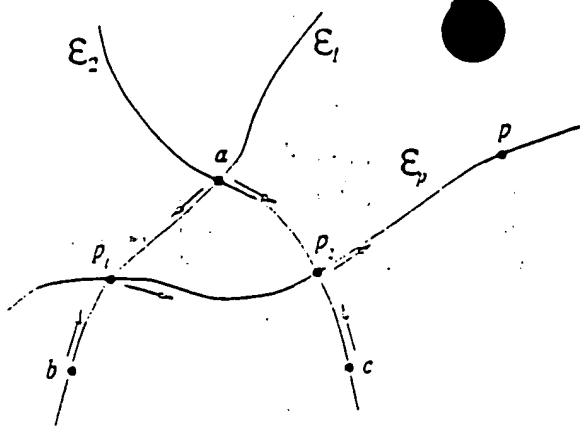


FIG. 10

CERN-SCAN-8602275

successive steps:

	Step 1:	**Acquire a set shadow images, extract the shadow edges and compute their intersections.**
1120	**Step 2:**	**Reject all isolated edges (and isolated groups of edges) so that the entire edge-web is fully connected (def. 2). Results a set of N edges $\mathcal{E}_i$, and N_p intersection points p_k.**
1130	Step 3:	Build the $2N \times 2N$ matrix **C** (eq. 7.10, 7.11 and 7.12), and compute the unitary seed vector $\overline{U}^o$ by SVD. Euclidean reconstruction is then achieved up to the three scalars α, β and γ.
1140	Step 4:	Select (at least) three points in the scene with known depths, and solve linearly for the remaining scalars α, β and γ (eq. 7.13).
	Step 5:	Compute the list of shadow plane vectors $\overline{\omega}_i$ (eq. 7.7 and 7.2) and triangulate all the points in the edge-web. The resulting set of 3D points may then be triangulated into a surface mesh for visualization purposes (fig. 7.5 and 7.6).

FIG. 11

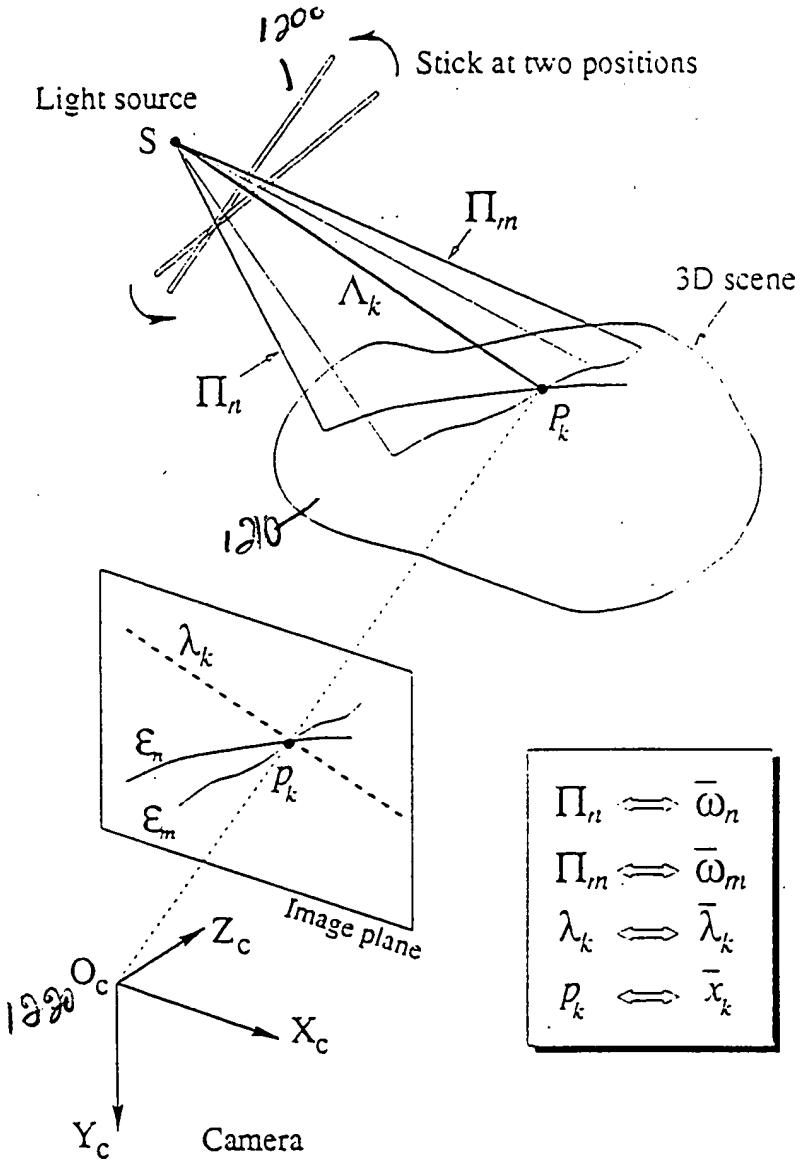

1200
Stick at two positions
Light source
S
Π_m
3D scene
Λ_k
Π_n
P_k
1210
λ_k
ε_n
p_k
ε_m
Image plane
Z_c
1220
O_c
X_c
Y_c
Camera
$\Pi_n \Longleftrightarrow \bar{\omega}_n$
$\Pi_m \Longleftrightarrow \bar{\omega}_m$
$\lambda_k \Longleftrightarrow \bar{\lambda}_k$
$p_k \Longleftrightarrow \bar{x}_k$

FIG. 12

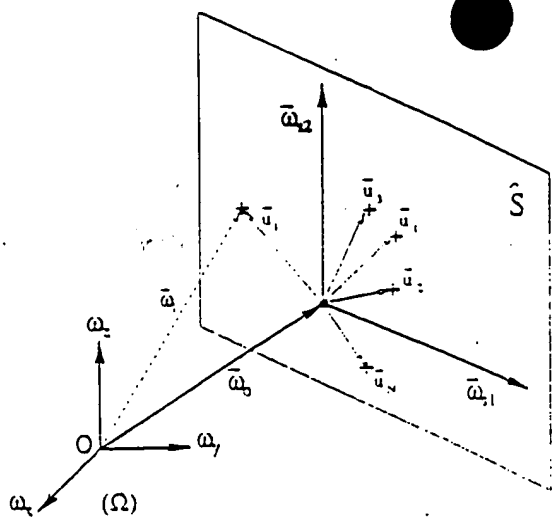

$\bar{\omega}_{x2}$
$\hat{S}$
$\bar{\omega}_{x1}$
ω_z
$\bar{\omega}_3$
O
ω_y
ω_x
(Ω)

FIG. 13

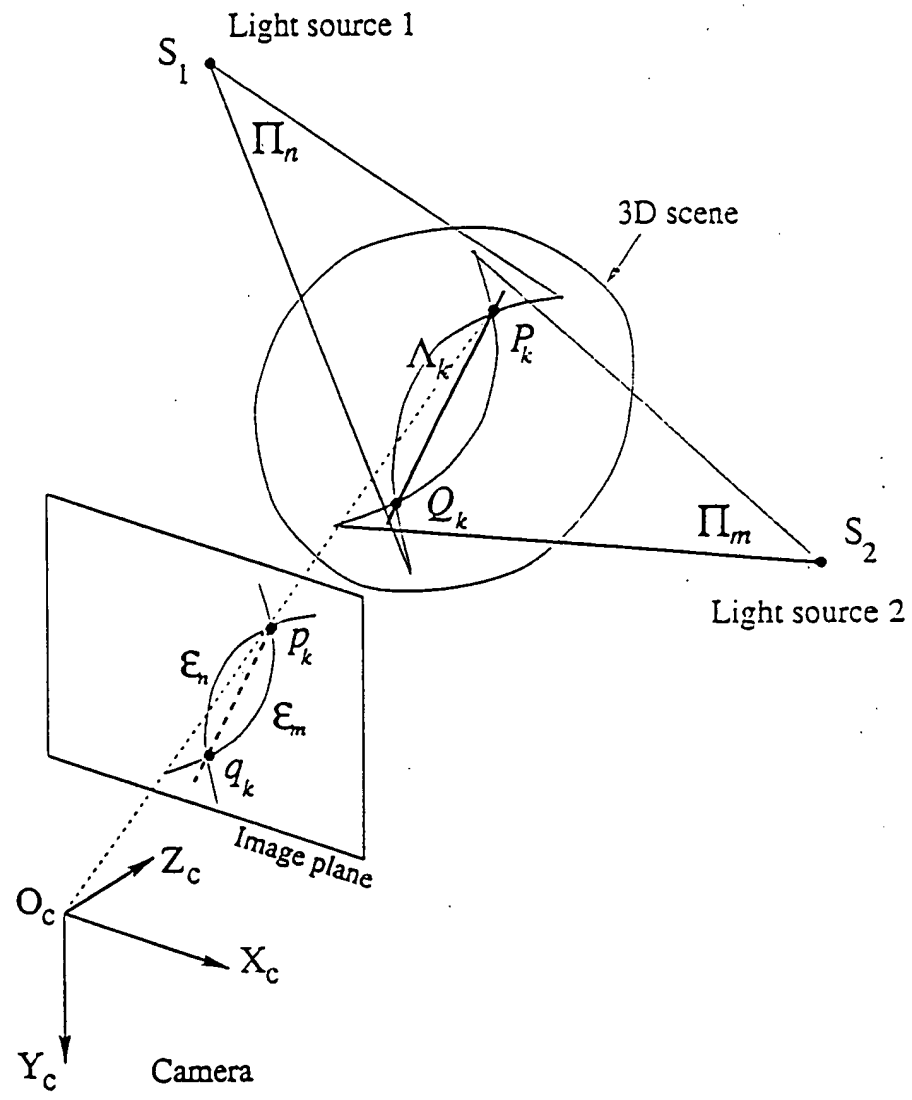

Light source 1
S_1
Π_n
3D scene
Λ_k
P_k
Q_k
Π_m
S_2
Light source 2
p_k
ε_n
ε_m
q_k
Image plane
Z_c
O_c
X_c
Y_c
Camera

FIG. 14

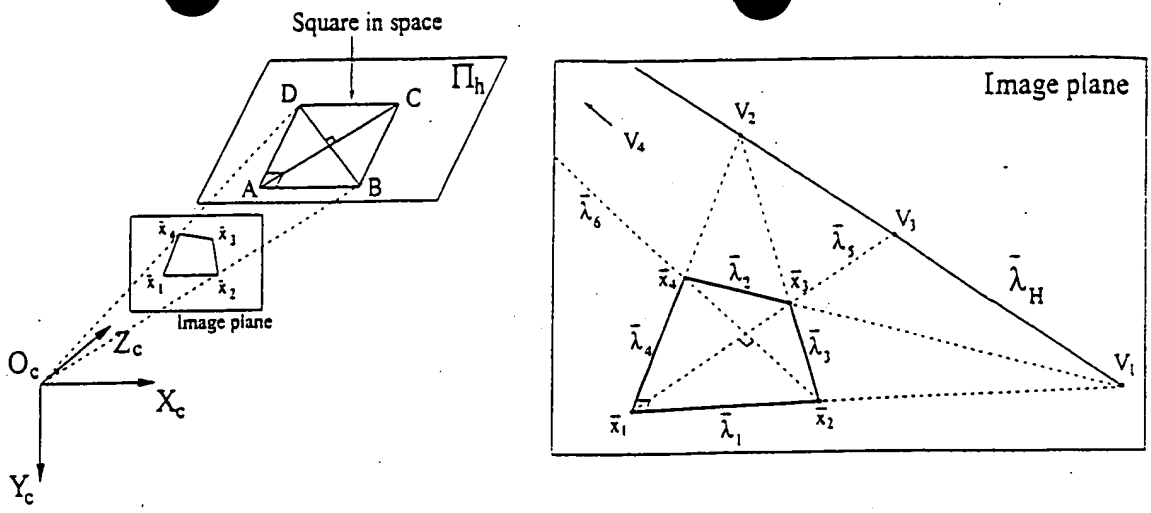


FIG. 15

US 6,535,210 B1

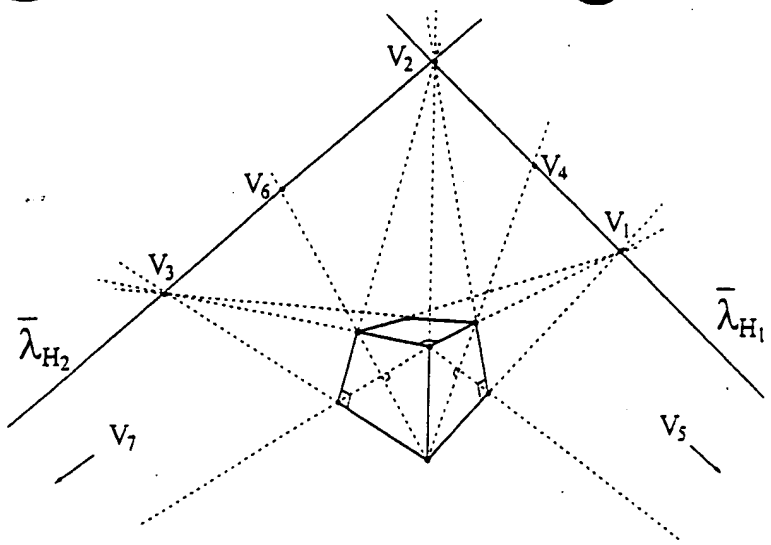


FIG. 16

0050505-4050505